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TO THE EDITOR OF SCIENCE: There is one point in Dr. Allen's letter of April 28 that I think will bear further emphasis. As he points out, most editors will print sound scientific "stuff" which they can get for nothing. But they won't pay a living wage to the man who writes it.

I have been doing this sort of work, off and on, for a quarter century. In fact, for some years I actually supported myself—at about the clerical level. Those were the days when "the Old Man" edited McClure's and cared more for the permanent repute of his magazine than for selling out any single issue. Newspaper work paid decently. One could occasionally make a short story of a scientific item. Even the women's publications used to buy semi-scientific articles on diet and child training.

Now all this is past; I haven't tried to sell anything since the war. It takes about as long to verify all the statements in one article as it does to write another. The verification is a labor of love, for which no editor will pay. The writer with an unhampered imagination can turn out stuff that the public prefers; and he can do twice as much of it in a day. My old market is absolutely dead. In the present day market, I can compete neither with the men who are selling their product, nor with those who are giving it away.

Dr. Allen's solution, I heartily agree, is for the moment the only practical one—though I doubt whether, in the long run, the public will get much good out of anything that it isn't willing to pay for. Nevertheless, I cannot help thinking that the condition which Drs. Allen and Slosson are trying to cure is only a symptom, not the real disease. For the fact is that the world just now is being simply drowned in a vast wave of superstition, that is bringing in every sort of pre-scientific opinion that the nineteenth century thought disposed of for good and all. My own town, for example, makes education its leading industry. But our public library has to buy books, just off the press, on palmistry, handwriting, character reading and fifty-seven other varieties of nonsense; while, significantly, it owns no old volumes on any such topics. The current number

of the *Atlantic Monthly* carries the advertisement of a professional astrologer!

Here then lies the real trouble: The reading public does not know good science from bad; but if it did, it would certainly choose the bad.

E. T. BREWSTER

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#### NOTES ON METEOROLOGY AND CLIMATOLOGY THE STREAMFLOW EXPERIMENT AT WAGON WHEEL GAP, COLORADO

STUDENTS of hydrology have always had a keen interest in the relation of run-off to the forestation of watersheds, and there has been much theorizing as to the probable relation. But there are so many factors involved—evaporation, transpiration, interception, etc., these, in turn, being influenced by the geological, phenological, and meteorological character of the watershed—that it is difficult, if not impossible, to estimate correctly the degree of influence of each. It has been the purpose of the Forest Service and the Weather Bureau to conduct an actual experiment in order to obtain quantitative measures of these influences and, in general, the response of streamflow to a forested and denuded watershed. The site selected for this large-scale experiment is near the railroad station of Wagon Wheel Gap, Colorado, the station having an elevation of 8,437 feet above sea-level. The plan was to select two contiguous watersheds of similar character, make extensive meteorological and hydrological observations on each, and, after the lapse of a certain number of years, denude one watershed of its trees and continue observations for a sufficient number of years to determine in what manner the streamflow is influenced.

On June 30, 1919, an eight-year continuous series of stream-flow observations and a nine-year meteorological record had been obtained, and, after a general survey of the results, it was decided that the trees could properly be removed from one watershed. The denudation was completed in the autumn of 1920. This, therefore, marked the completion of the first stage of the experiment. Observations are being continued, and will continue for several

years, but the report on the first stage has just been published.<sup>1</sup> The Forest Service is represented by Carlos G. Bates, silviculturist, and the Weather Bureau by Professor A. J. Henry, meteorologist, the reports representing joint authorship.

While an effort was made to select watersheds of similar character, it is obvious that, no matter how good the general agreement of the main features, exact duplication was impossible. Watersheds *A* and *B* at Wagon Wheel Gap, therefore, have certain characteristics in which they are quite different. Through these two small valleys flow tiny streams which descend toward the Rio Grande. The streams are approximately parallel in their lower portions and flow, in a general direction, from west to east. The area of the south watershed, *A*, is 222.5 acres and that of the north watershed, *B*, is 200.4 acres. The lower point of *A* is 9,373 feet and the upper point 11,355 feet above sea-level. Corresponding elevations for *B* are 9,245 feet and 10,952 feet above sea-level. These facts are not as significant, so far as this study is concerned, as the fact that watershed *A* is relatively long and narrow, while *B* is short and fan-shaped. These characteristics exert considerable influence upon the rate of runoff, for, owing to the short, steep, slopes of *A*, the flood crest arrives more quickly than in *B*, but falls sooner, then comes to a secondary maximum of longer duration, because of the greater length of the watershed. The flood at *B* exhibits no secondary maximum because the water reaches the dam from all

<sup>1</sup> Bates, Carlos G., and Henry, Alfred J.: "Streamflow Experiment at Wagon Wheel Gap, Colo." *Mo. Weather Rev. Supplement No. 17*, pp. 55, figs. 41. A very complete paper representing a summary and extracts from the *Supplement* was published in the *Mo. Weather Rev.* for December, 1921, under the same title, pp. 637-650. Believing that separates of this shorter paper will satisfy those who have an academic, rather than a professional, interest in the subject, a limited number of reprints are now available. Application should be made to the Chief of the Weather Bureau, Washington, D. C. Copies of the complete report, *Supplement 17*, may be obtained at 50 cents each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

parts of the watershed at approximately the same time. Moreover, *A* and *B* lying in different directions, as explained above, involves a difference in the rate of snow melting owing to the different exposure of the slopes to the sun; this has an effect upon the streamflow. The geological character of the two watersheds has been found to be the same. The trees consist largely of Douglass fir, although there is a considerable sprinkling of bristle-cone pine and Englemann spruce, the distribution depending upon the altitude, the exposure of the slope, and the amount of rock in the soil.

The observing equipment is of two kinds, meteorological and hydrological. Six primary meteorological stations were established at the beginning of the experiment, one at the base and one in the upper reaches of the streams, and two in each of the valleys. The equipment of these stations varies according to the topographic features in the vicinity; but, among them are to be found maximum and minimum thermometers, psychrometers, thermographs, soil thermoscopes, hygrographs, anemometers, raingages, and snow bins. The headquarters station is the most completely equipped, having two standard barometers, and a triple register for recording automatically wind direction and speed, precipitation and sunshine. On *A* there are 18 snowscales—graduated stakes 12 feet high—and on *B*, 14 scales, the location of each having been carefully selected so as to be representative of the snowfall on a given acreage.

The hydrological equipment consists of a dam in each stream so constructed as to make the surface and subflow of the streams available for measurement. Back of the dams are concrete basins in which continuous automatic record of the waterstages is kept by a Friez recorder. The instrumental record is checked daily by a reading with the hook gage, the latter being so accurate that several observers do not differ more than 0.001 foot on a given reading. The dams at first had rectangular weirs, but for these triangular weirs were later substituted.

The following facts are shown by the nine years of meteorological observations: (1) The mean minima for identical periods and times are slightly higher for slopes facing south than for those facing north, but the greatest differ-

ence for any month does not exceed  $1^{\circ}$  F. Comparing corresponding slopes of the two watersheds, the mean temperature is substantially the same. (2) Precipitation occurring as rain is practically equal on both watersheds. If the soil is saturated, as small a rain as 0.01 inch may cause the streamflow to respond; but ordinarily rains of 0.10 inch or less in summer merely replenish losses due to evaporation or transpiration, and do not affect streamflow appreciably. Most of the summer rains are not in excess of 0.25 inch, hence it is seen that summer rains are not, in general, of great importance. (3) A little less than 50 per cent. of the precipitation is snow, but it yields more than half the runoff. The average depth of snow per season is 113.3 inches. The maximum observed was 149.7 inches and the minimum 80.7 inches.

Interesting features of the streamflow records are: (1) Stream *A* rises more rapidly than *B* and reaches a maximum sooner than *B*, but before the flood has subsided a secondary maximum with a steadier flow may occur at *A*. This feature, as mentioned above, is easily explained by topography. (2) Winter and autumn show very little diurnal variation of streamflow; summer is more marked, with a maximum in the early morning hours and a minimum between 1 and 2 o'clock in the afternoon; spring, however, with the great amount of melting snow, has a pronounced diurnal period owing to alternate freezing and thawing. The amplitude of variation is greater at *A* than at *B*, and the *A* maximum and minimum are more pronounced. (3) An estimated disposition of 21.00 inches of precipitation, the average annual amount for eight years observations, is shown for *A* as follows:

Evaporation	7.39 inches
Transpiration	3.91 inches
Interception	3.62 inches
Runoff	6.08 inches
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Total	21.00 inches

It is clear that the objective of all these studies is an accurate estimate of the relations between the various factors on *A* and *B* in order that, in the years following denudation, the conditions on *A* can be used as an index

to what would have occurred on *B* had denudation not been effected. It is only in this way that the effect of the presence or absence of trees can be ascertained. Much of the paper, therefore, is devoted to these relations in too great detail for abstracting. Thirteen "rules" are developed as statements of these relations to be used in the later discussions. These concern ratios of discharges in different periods and at different times, time intervals between crests, probable height of crests, and the deposition of silt.

This experiment is of great practical importance with respect to hydrological problems—floods, irrigation, etc., and its outcome will doubtless be watched with the greatest interest by those who are concerned with these problems.

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## SPECIAL ARTICLES

### AN EARLY STAGE OF THE FREE-MARTIN AND THE PARALLEL HISTORY OF THE INTERSTITIAL CELLS

THE theory that the intersexual condition of the free-martin depends upon hormones secreted by interstitial cells of the testis of the male twin and distributed by its blood to the female depends primarily upon the demonstrated connection between foetal vascular anastomosis and the intersexual condition of the female twinned with a male calf, and secondarily on comparative data. The time of effective action of the male hormone has been presumed to be very shortly after the beginning of sex-differentiation in the embryo (Lillie, '17) owing to the known normal condition of the embryonic membranes in such stages, which renders vascular connection possible, and the very profound nature of the effect. The earliest stage of the free-martin hitherto described is 7.5 cm greatest length (Lillie, '17; Chapin, '17). Sex-differentiation begins at approximately 2.5 cm. The gap thus indicated in our knowledge of this phenomenon is now largely filled up by study of a free-martin of 3.75 cm greatest length, and of the complete history of the interstitial cells of the testis and ovary from 2.5 cm throughout life.